AGRICULTURE - SOIL SURVEY

⑪

1

American Embassy
Jidda, Saudi Arabia
July 17, 1954

MEMORANDUM

TO: Dr. W. J. Edens, Chief
Agriculture Division

FROM: George P. Gibbs
Soils Specialist

SUBJECT: Preliminary Soil Review - farm of Shaikh Abdullah Sulaiman, Jidda.

On July 3, 1954 a brief study was made of the soils on the farm owned by Shaikh Abdullah Sulaiman located south of the Mecca road about five kilometers east of Jidda.

Soils on this farm are very light in texture, consisting mostly of sand and gravelly sand. These soils are stratified and of recent stream deposition. There is slight cementation probably due to phosphate and calcium cemented in the soil. The texture grows lighter with depth, and layers of highly cemented materials are found.

Because of the light texture of the soils found, infiltration rates were run to determine water requirements and ability of the soil to retain moisture. Twelve inches of water was added to thoroughly moisten the soil, then infiltration tests began. The lighter textured soils found in the west and northwest portions of the farm allowed 20 inches of water an hour to enter. In the eastern and southern portions of the farm, the soils allowed 12 inches of water to enter an hour.

These permeability results would indicate that this soil is too light and leachy to make irrigation practical. With soils taking water as fast as 12 inches per hour, it would be necessary to irrigate short runs with a large head of water. Moisture retention in such a light soil is poor and therefore frequent irrigations would be necessary. Because of the leachy nature of this soil, soil nutrients would be depleted rapidly and erosion would be a problem. A special effort would have to be made to maintain high organic matter content with frequent applications of commercial fertilizer.

Laboratory results obtained by Dr. Glen F. Brown indicate that the water to be used for irrigation is of fair quality. The salt content is as follows:

Salt	Parts per million
Calcium	76
Magnesium	40
Sodium and potassium	521
Bicarbonate	168
Sulphate	304
Chlorine	738
Carbonate	7
Total dissolved solids	1,854
Total hardness (as $CaCO_3$)	360
pH	7.8

Using flood irrigation, water carrying this amount of salt would easily leach the salt from the soil with frequent heavy applications. With sprinkler irrigation, salt would accumulate and frequent over irrigation would be necessary to leach the salt out of the soil.

GPGibbs:mep

Soils

American Embassy
Jidda, Saudi Arabia
July 17, 1954

OFFICIAL - INFORMAL
UNCLASSIFIED

Mr. W. S. Middaugh
Near East Area Advisor
Agricultural Programs Division
Foreign Operations Administration
Washington, D. C.

Dear Mr. Middaugh:

I am attaching two reports prepared by our Soils Scientist, George P. Gibbs, one covering Wadi Khulais Land Classification and the other covering Reconnaissance Land Classification of a Portion of Southern Tihama. Both areas were to have come under our Community Development project.

I think both of these reports are very good ones and show Mr. Gibbs' comprehension of his specialty. You may want to have these retained in your files for future reference.

Sincerely yours,

Harland J. Corson
Director
USA Operations Mission
to Saudi Arabia

Enclosures - 2
As above

HJCorson:o

0 Soil ①

American Embassy (USOM)
Box 3, APO 616, c/o PM
New York, New York
July 10, 1954

Dr. O. S. Aamodt
Research Center
Beltsville, Maryland

Dear Dr. Aamodt:

Under separate cover I am sending you some soil samples from Saudi Arabia for fumigation.

I would appreciate it very much if you would then forward this package to the SALINITY LABORATORY, RIVERSIDE, CALIFORNIA.

Sincerely yours,

George P. Gibbs

GPGibbs/bc

0 Sol ①

American Embassy (USOM)
Box 3, APO 616, c/o PM
New York, New York
July 10, 1954

Dr. A. D. Ayers
Salinity Laboratory
Riverside, California

Dear Dr. Ayers:

The package of soil samples I sent to you has just been returned to me while I was trying to locate it. There is no explanation so I will attempt once more and send it first to Washington for fumigation.

We are now being given the same treatment you were when you were in Jidda. Hope we can go to work soon.

The package will probably come "surface" and may take three months or more.

Thanks for your interest.

Sincerely yours,

George P. Gibbs

~~GPG:bc~~

GPGibbs:bc

1

American Embassy
Jidda, Saudi Arabia
July 1, 1954

MEMORANDUM

TO : Dr. W. J. Edens, Chief
Agriculture Division

G.P.G.

FROM : George P. Gibbs
Soils Specialist

SUBJECT: Reply to letter from Fred Barham discussing land, fertilizer, and water management, dated May 16, 1954.

I heartily agree with Mr. Barham in the matter of an urgent need of an experiment station in the area in which he is working. Not until an experiment station has been operating for sometime can we hope to answer all the questions now obvious. Real familiarity with the area would raise many more questions which would require years of research to answer. An experiment station would also serve as a training center.

Since I was in the area only a very small portion of a year - about a month - I do not feel qualified to give full or complete answers to all questions. However, I will give such explanations as I believe to be the probable answers.

Question:

Colorado River water contains one ton of total soluble salts (TSS) per acre foot of water. Dammam water contains 5.9 tons of TSS per acre foot. Irrigation with six feet of Colorado River water requires careful drainage. Twenty-three feet of water is applied at Dammam with no drainage and plants still live. How come?

Answer:

I believe the answer here is in the difference in evaporation rate and natural permeability of the soil.

In the Imperial Valley in California where the Colorado River water is being used for irrigation, evaporation is high. The Salton Sea loses seven feet of water a year by evaporation. The soils are comparatively heavy and natural internal drainage is poor compared with the soils of Dammam.

At Dammam, most of the water leaches away through the porous soils and carries the salt with it. If it evaporated, it would deposit about 135 tons of salt on each acre of land each year.

Plants do continue to grow in the Dammam area but they lack vigor because of over-irrigation, soil depletion, salt, and other management factors. Compare alfalfa in the Imperial Valley with alfalfa in the Dammam area. In the Imperial Valley, it produces 14 tons of good quality dry hay for from three to seven years when it is turned under for soil building purposes. At Dammam, alfalfa does well to remain productive nine months, at the end of which time something else or more alfalfa is planted because little or no alfalfa remains or at least there is not enough to justify harvesting or plowing under.

Question:

Samples taken by Guy Hamilton and analysed by Aramco show the following: P_2O_5 - about 6,000 pounds to the acre furrow slice. K_2O-about 4,500 pounds per acre furrow slice. This is a lot of phosphate and potash. What does this mean?

Answer:

In the States, an acre furrow slice is often used as a convenient yardstick for comparison. Guy Hamilton told me he took soil samples to about one foot depth. I projected these findings into an acre furrow slice. An acre furrow slice is the soil ordinarily turned by a plow over an acre area or approximately 2,500,000 to 5,000,000 pounds of earth.

In an area like Dammam, the phosphate could be tied up in compounds, which are slightly if at all available for plant use. Organic matter was low in most of the soils visited so organic acids would release little phosphate for plant use. Tree and plant roots were often limited to an area of only a few cubic inches, and since most phosphate compounds are very slowly soluble, little would be carried to the plant roots by moving soil solutions.

Potash is sometimes called a luxury fertilizer because the plants will often take up more potash even though it is not needed for healthy plant growth. The average potash content to be found in soils is about 0.15% or about 1.87 tons for the acre furrow slice. Compare this figure with the results obtained by Guy Hamilton which show about 2 1/4 tons to the acre furrow slice and we can see that the soils in the Dammam area are not unusually high in potash.

Question:

Some farmers in the area apply potash with good results. Can George explain this?

Answer:

With the limited root growth of the plants at Dammam, any potash applied to the surface would probably be more readily available for plant use than that stored, and perhaps fixed, in the soil.

I would like to have more information about the potash being applied. What is the source and quality? How is it applied and to what crops? What is the crop response? At what intervals are applications of potash made?

GPGibbs:mep

①

American Embassy
Jidda, Saudi Arabia
June 27, 1954

MEMORANDUM

TO: W. J. Edens, Chief, Agriculture Division

FROM: George P. Gibbs, Soils and Agricultural Research Specialist G.P.G.

SUBJECT: Monthly Progress Report - June 1954

Army maps of Saudi Arabia were mounted on cloth for field use when further field work is to be continued.

Soils were briefly examined and a report prepared on the farm of Shaikh Abdullah Sulaiman to assist in planning future land and water management on this farm.

Much of this month was taken up training an Arabian to service air conditioners and replace air conditioners where breakdown made replacement necessary.

Equipment has not yet been received with which to make moisture determinations, wilting point, and other soil and water studies.

GPGibbs:o

Supplement

Preliminary Soils Review - farm of Shaikh Abdullah Sulaiman
Jidda

Mapped June 22, 1954

Referring to conclusion, paragraph 2, of the preliminary soils review of the farm being developed near the airport by Shaikh Abdullah Sulaiman, Dr. Glen Brown has made the salt analysis results available. Following is a discussion of this analysis.

Old dibble north of Mecca road - now being reppened:

Water quality - June 1954

Ca	Mg	Na (plus K)	HCO_3	Cl	SO_4	T.S.S.
112	110	1850	280	2116	1480	5948

The above figures express parts per million of total soluble salts (T.S.S.). Expressed in another way, one acre foot of water weighs approximately 2,720,000 pounds. This would give us the following information, using the above figures:

If 12 inches of water were applied at an irrigation, this would deliver about eight tons of salt per acre. Twelve inches is seldom applied at an irrigation, but where salt is high, heavy applications are necessary to leach salt away and to furnish the abundance of water necessary for the plant to compete with the salt in the water.

Total soluble salts in this water are so high that crop failures due to total salts can be expected. Sodium salt alone is so high, and is not balanced with an equal amount of calcium and magnesium, that it would soon develop a condition in the soil making it completely useless for irrigation.

George P. Gibbs

UNITED STATES OF AMERICA
~~TECHNICAL COOPERATION ADMINISTRATION~~
USA OPERATIONS MISSION TO SAUDI ARABIA
Jidda

March 6, 1954

Salinity Laboratory
Riverside, California

Dear Sirs:

In a separate package I am sending soil samples from the sabakhas on the east coast of Saudi Arabia. Many people are interested in reclaiming these soils. I will appreciate any comments you may have to offer.

There is an abundance of water from flowing wells. Aramco has given me the following information on water quality:

Dammam Wells

Flowing	Date	Na	Ca	Mg	SO_4	Cl	HCO_3	T.S.	pH	Specific Gravity
	8/31/53	553	231	76	413	1058	207	2538	7.2	1.003
	10/3/53	559	230	74	429	1051	201	2544	7.2	1.0028
	10/18/53	462	220	68	409	909	204	2282	7.5	1.003
	9/23/53	486	224	66	450	884	210	2320	7.2	1.0025
	9/23/53	485	226	70	446	909	195	2331	7.1	1.0025
	9/23/53	475	224	74	441	909	189	2312	7.1	1.0025
	9/24/53	476	226	71	441	902	195	2311	7.2	1.0025
	8/31/53	476	222	70	437	888	207	2300	7.5	1.002
	9/14/53	468	227	71	446	888	195	2295	7.2	1.003
	9/16/53	475	220	71	454	880	195	2295	7.15	1.003
	9/23/53	496	222	73	490	898	192	2371	7.2	1.0025
Not Flowing	9/14/53	504	224	74	441	944	207	2394	7.4	1.003
Dammam Drains										
	10/18/53	729	365	171	1106	1345	189	3902	7.8	1.004
	10/18/53	630	376	129	1073	1115	183	3506	7.7	1.004
	10/18/53	578	426	139	1094	1122	210	3569	7.6	1.004
	10/19/53	524	315	104	668	1061	214	2889	7.6	1.003
	11/2/53	602	291	100	656	1129	210	2988	7.8	1.002
Qatif Wells										
	1/19/52	319	162	170	437	838	195	2121	7.6	
	51	337	184	67	365	664	183	1800	7.2	

The area to be reclaimed is free from vegetation, though crusting salt on the surface is lacking. The topography is nearly flat, rising from high tide to perhaps as much as six feet above high tide. Because of danger of salt water entering from the Persian Gulf, it will probably be impossible to drain this land to a depth greater than two to six feet.

It may also be of interest to you that some soil in the area is being irrigated and the farmers are now applying about 23 feet of water a year. Evaporation is low and drainage is poor. Crops are responding to this treatment as you might expect. Date palms were found with roots not over 20 inches long. Oranges and grapes will not grow. Other crops, fruit and vegetables look sick. Possibilities for improving water management are great.

Please send a copy of results and comments to:

O. S. Aamodt
Research Center
Beltsville, Md.

C. W. Baker
2730 N.W. 4th St.
Miami 35, Florida.

Attached is a description of the soil samples.

Very truly yours,

George P. Gibbs
Soils Specialist

Attachment

GPGibbs/pa

UNITED STATES OF AMERICA
~~TECHNICAL COOPERATION ADMINISTRATION~~
USA OPERATIONS MISSION TO SAUDI ARABIA
Jidda

IDENTIFICATION OF SOIL SAMPLES

Package No.

1 Contains 3 samples in profile as follows:
Top 3 inches
3" to 15" horizon
15" to 30" horizon
This series of soil samples was taken in a sabahka on the Ras Tanura Road northwest of Qatif, Saudi Arabia. Salt water seeped in at the 30" horizon.

2 Contains 3 samples in profile as follows:
Top 8 inches
8" to 20" horizon
20" to 30" horizon
This series of soil samples was taken near the Dammam-Al Khobar Road inside the Saudi Government Railroad Customs Compound. It is near sea level and water appears in post holes on the property during high tide within 24 inches of the surface.

3 Contains 3 samples in profile as follows:
Top 6 inches
6" to 15" horizon
15" to 28" horizon
This series of soil samples was taken in a rice paddy in the farming area near Hofuf, Saudi Arabia. The land was soaking wet when the samples were taken because of several days rain.

4 Contains two soil samples taken from the top 6 inches of surface soil. The location is near sea level on the Gulf side of the Dammam-Al Khobar Road opposite the Saudi Government Railroad Customs Compound. This area supports some grass tentatively identified as a member of the Eragrostis family. This grass provides some forage year-round for cattle, especially camels. Another plant called Aakroosh by the locals is also to be found growing in this area.

5 Contains two samples of soil taken from the surface 6 inches and 10 inches. Samples were taken on the north side of the road leading from Dammam to the Ras Tanura Road. Several grasses are to be found thriving in this area and seeded rather heavily during early November. Most of the vegetation found in this area was very rhizomotous and vigorous. In early October, soil moisture was found about 10 inches below the soil surface with roots of the grasses and other vegetation well established in this horizon.

6 Contains one soil sample taken from the top 6 inches in a location south of the pipeline from Qatif to Ras Tanura, north of the Qatif Pumping Station. Moisture at 10".

5 [illegible]

①

UNITED STATES OF AMERICA
~~TECHNICAL COOPERATION ADMINISTRATION~~
USA OPERATIONS MISSION TO SAUDI ARABIA
Jidda

March 2, 1954

Mr. Abdullah Dabbag
Assistant Director General of Agriculture
Ministry of Agriculture
Jidda, Saudi Arabia

Dear Abdullah:

I recall promising to forward to you the preliminary observations made by Mr. George Gibbs, soil scientist, when he made a brief study of the Experiment Station at Kilo 10. The observations and suggestions made are indicative of conditions that now exist. You and Mr. Bodkook may want to make a more detailed study.

Assuring you that we want to cooperate every way we can, I am

Sincerely yours,

W. J. Edens, Chief
Agriculture Division

WJEdens/pa

~~[illegible]~~
~~[illegible]~~
File
Soil

xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

USA OPERATIONS MISSION TO SAUDI ARABIA
Jidda

MEMORANDUM February 21, 1954

TO : Dr. W. J. Edens, Chief
Agriculture Division

FROM: George P. Gibbs
Soil Specialist

RE : Suggested Items for an Agricultural Improvement Program for Hofuf, Qatif, and Dammam.

	Oasis	
	Hofuf	Qatif & Dammam
1. Education.		
Water Management - Irrigation water should be applied according to the needs of the crops. Close supervision should be given until rates can be established and methods of measuring water can be developed which can be followed by the farmer to give maximum return in yields.	X	X
Organic Matter - Methods of application and supplementing manure and crop residue for maximum yields should be taught. Dried up manure and burned litter adds little except phosphate, potash, and cellulose. Nitrogen, which is seriously needed, is destroyed.	X	X
2. Map present system of irrigation and drainage. Perhaps this should start with only a small sample area of one farm unit or less. Elevations, source of water, irrigation canals, drainage ditches, roads, buildings, and soils should be mapped with considerable detail to aid in discussing problems and revising system for efficiency of the individual farm and an over-all project plan.	X	X
3. Improvement Demonstration - A farm unit or suitable portion of a farm which can be developed as a unit should be set up to demonstrate improved methods. More than one such unit may be required for each oasis.	X	X

	Oasis	
	Hofuf	**Qatif & Dammam**
4. Stabilize Stream Flow. Baffles or flash board structures should be placed in canals and ditches to assist farmers in meeting water requirements when stream flow is low.	X	
5. Highway Improvement - Bridges should be placed and roads straightened or placed on contour to release land for cultivation and shorten the distance of hauling farm produce and prevent destruction of road beds by surplus water.	X	X
6. Space plantings according to the growth habits of the plant. Yields can often be increased by reducing the number of plants in a given area of land so that plants do not have to make a spindling growth for sun light or compete with two or three others in an area where there is only enough food for one plant.	X	X
7. Avoid production of crops in same area which have wide differences in water requirements. Citrus fruit, dates, and alfalfa prefer well drained soils with a water table below six feet. Rice does well flooded. These fruits should not be raised where rice is to be grown.	X	X
8. Determine duty of water and return flow for maximum production. It may be necessary to run field trials and collect water and soil analyses to determine minimum water requirements for maximum crop yields and to allow flushing water to prevent salt accumulation.	X	X
9. Drainage Investigation - Permeability can be run with disturbed and undisturbed samples of soil to roughly determine ditch spacing for drainage. Very accurate determinations of ditch spacings and effect of salt water from the Gulf underflowing the area by the use of draw down wells. A large well is pumped to a certain level while small wells, placed radiating from the large one, are watched for influence of the lowered water table.	X-few	X-many
10. Rotations - Rotations should be studied to determine how to meet the economic requirements of the farmer, increase soil organic matter and fertility to the maximum, avoid overlapping of peak seasons of water requirement and distribute farm labor and farm income. A good rotation should also aid in weed control, control of disease and insects, and allow for the production of crops adapted to the area.	X	X

	Oasis	
	Hofuf	**Qatif-Dammam**
11. It is believed that the health, and therefore the working capacity, of the farm people could be greatly improved by drilling wells where unsanitary conditions make the present source of water undesirable for human consumption.	X	
12. Better transportation systems. Long time programs should be worked on to provide bridges and sufficient roads to shorten hauls and save valuable time and energy.	X	X
13. Stabilize Shifting Sand. Plant tomarisk and native forage plants on sand dunes to stabilize them and provide controlled grazing. Cultivated land and wells are being made useless by shifting sand.		
14. Where drainage improvement is limited by location or topography, plants of agricultural value should be selected with growth habits suitable for the location.	X	X
*15. Swamps now provide litter to be burned before spreading on the land. They also produce mosquitoes in great numbers. They should be drained, improved for the production of organic matter, or improved for the production of fish for human consumption.	X	
16. Fish, for human consumption, should be placed in open ditches wherever practical.	X	X
17. Trees should be planted near lakes for firewood and lumber.	X	

*It may be possible to introduce bamboo and elephant grass to serve as building materials and green manure.

Improvement to be expected 100%   60%

GPGibbs/pa G. P. Gibbs

Soil Survey (1)

USA OPERATIONS MISSION TO SAUDI ARABIA
American Embassy - Jidda

VIA AIR POUCH
UNCLASSIFIED

February 2, 1954

Mr. George Gibbs
c/o American Consulate
Dhahran, Saudi Arabia

Dear George:

According to what Mr. Corson stated to me, it appears that I should have had a report from you before this date. I assume you are making the reconnaissance study for the purpose of formulating a program of work on that side.

This is a budget-making period with the Ministry, and I suggest that you return to Jidda in the near future so that matters can be discussed and recommendations made concerning work at Qatif and Hofuf.

I have just written to Fred concerning his work and our efforts to get his living costs better adjusted. It is hoped you are meeting with success and that the groundwork you are now doing will be of much value.

The family seems OK and all send their regards.

Sincerely yours,

W. J. Edens
Chief, Agriculture Division

PS - On Mr. Corson's directions, Skrinde has just forwarded funds and a grocery order to you for families of the Mission. Please have the same shipped as requested.

WJEdens:o WJE

Soil

~~Ag Lowsp~~

U.S. Operations Mission
to Saudi Arabia
Jidda

November 22, 1953

MEMORANDUM

TO: Dr. W. J. Edens, Chief, Agriculture Division

FROM: George Gibbs

SUBJECT: Kilo 10 Farm - Observations and Preliminary Suggestions

An impervious layer, granite or basalt, underlies much of the farm.

Much of the area being farmed is underlain by a shallow layer of unconsolidated carbonates at about 75 to 100 cm.

During irrigation, the water table stands at about 50 cm. on the north side of the farm, dropping off slowly until about 100 cm. depth is reached on the south side. Across the road to the south no moisture saturation was reached at 250 cm.

Standing water in the drainage ditch at the center of the farm has a salt content in excess of 3500 parts per million.

Irrigation water being used had a salt content of less than 500 parts per million Nov. 10, 1953.

Trees do not look healthy and most of the light bloom has fallen to the ground. Of this light bloom some fruit made considerable growth and then fell. A few fruits still cling.

Nutrient deficiencies now showing in the foliage are calcium, zinc, manganese, magnesium, and perhaps iron. Calcium deficiency is especially noticeable in the young trees.

Other deficiencies can be expected to show themselves if the above are corrected and improved tree growth increases demands on the soil.

Some yellowing of foliage has been corrected by application of iron. This was done by the manager, who is also preparing compost and bones for fertilizer.

Suggestions:

Information should be gathered on source and amount of iron applied. Information should also be gathered on the method of preparing compost and bone fertilizer. If bones are being burned, some application should be made without burning.

Drainage should be improved to keep the water table below 130 cm. wherever bed rock will permit. Scattered open wells, perhaps one in each 100 X 50 meter plot, should be established for the purpose of watching the water table. This can be done by placing a two inch galvanized pipe at desired points and capping them with tin cans.

Lighter and less frequent applications of water should be applied on sandy loam soils such as those found on the Kilo 10 farm.

It would be well to change from basin to furrow irrigation in a portion of the orchard and then watch the depth of water penetration during and following irrigation. By avoiding saturation of subsoil, root growth can be stimulated.

Deficiencies should be corrected by spray or fertilizer or both, and the results carefully watched.

At the Kilo 10 farm, textures are light, leaching is probably severe, and temperature of soil high. This could at least be partly corrected and at the same time nitrogen could be added by the use of a green manure crop containing a legume. It would be my suggestion that several green manure crops be tried out, both from the standpoint of producing human food soil protection, and at the same time avoiding competition with the fruit trees for nutrients. Green manure crops should also be tried in rotation with vegetables being grown in the area. As a green manure crop, deep rooted legumes should be avoided.